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(54) Novel method of producing punctual weld joints by means of a friction stud

Description

The invention relates to a method of producing a punctual weld joint between two or more work pieces by means of a rotating friction stud, especially to a method of producing a joint, wherein at least one work piece has a thin-walled cross-section at the location of the joint.

Different joining techniques for producing spot weld joints have already been known. In the automobile industry particularly the electrical spot weld joints have won recognition in connection with thin sheets.

In practice, however, these joints have generally been adopted only in connection with steel sheet constructions. Thus, the welding electrodes used for spot welding aluminium sheets become unserviceable after a few welding procedures already.

In view of the nowadays increasingly used materials such as aluminium and magnesium, and the material combinations aluminium/steel, magnesium/steel, magnesium/aluminium, the joining technique by means of a rotating friction stud constitutes an essential improvement.

Considerable quality improvements in view of the stability, the use of different material combinations as well as the optical property can be achieved. The preparation of materials and the use of additional materials are not necessary. Compared with electrical spot welding the tool lives in connection with aluminium and magnesium are nearly unlimited.

The application is based on the object to develop a spot welding method such that it is possible to join modern materials and different material combinations in a stable, fast, reliable and inexpensive way.

According the invention this object is provided by the features of claim 1, wherein a rotating stud penetrates from the opposite side of the joint zone into one of the work pieces to be connected in a horizontal position. The friction and the pressure generate an intensive local temperature rise in the joint zone, which, in connection with the simultaneous micro-deformation in the joint zone, causes the passive layers to tear open. Similar to the pressure welding process, the pressure produces a non-detachable joint between the work pieces.

The invention shall hereinafter be explained by means of an embodiment and drawings.

Figures 1 to 4 show the cross-sectional views of two work pieces in consecutive phases during the production of a work piece assembly without a remaining friction stud. Figures 5 and 6 show the phases during the production of an assembly with a remaining friction stud (3). Figures 7 to 8 show improvements of the method, with Fig.

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7 illustrating a bead separating device (6) and Fig. 8 a holding-down device (7). Fig. 9 shows how an assembly of more than two work pieces can be produced.

Fig. 1 shows two plate-shaped work pieces 1 and 2 lying on one another, which may be sheet metals or parts of hollow sections to be connected with each other. The position of work piece 2 has to be fixed versus the rotating stud by means of a counter-holding force. A rotating stud (3) is moved against the upper surface of work piece 1 and is firmly pressed against both work pieces by maintaining its rotation, without entirely penetrating work piece 1. Since high energy volumes are set free within a short time due to the friction, local temperature rises occur in the area of the joint zone (4). The micro-deformations on the upper surfaces resulting from the temperature and the pressure cause the passive layers in the area of the joint zone (4) to tear open. The high-energy active layers underneath thereof are capable of being combined. Similar to the pressure welding process, the joining process now takes place as a result of pressure and temperature. Subsequently, the stud may either be withdrawn from work piece 1 (Fig. 4) or may remain on the work piece assembly (Fig. 6).

In the case where the stud, being a stationary unit of a welding apparatus, is withdrawn (Fig. 4), the friction stud should preferably be made of a material having a higher melting point and good wear properties, since it is subjected to a permanent temperature and stress due to wear. Apart from metallic materials, also ceramic materials are therefore particularly taken into consideration.

If the stud (Fig. 5) is used as part of the combined body, a detachable connection from the driving unit must be provided. This may be achieved, for instance, by positive locking (e.g. hexagon socket) or a frictional connection (e.g. spring collets). Like with the conventional friction welding, the stud is thereby brought near the metal sheet, is rubbed in, stopped and, if required, pressed in once more (Fig. 5). Subsequently, the driving unit (8) is decoupled from the welded stud and is withdrawn (Fig. 6).

Since a welding process also always involves the formation of a bead (5), the apparatus may be provided with a device (6) for twisting off the beads in the form of a

milling cutter (Fig. 7). The same may fixedly co-rotate with the friction stud, or may be brought near the bead subsequently.

It may be another advantage to fix the work piece 1 by means of a holding-down device (7) (Fig. 8) The work pieces 1 and 2 are thus unable to be lifted off from one another, with the result that, above all in the area of the principal heat input at the circumference of the stud, the work pieces are always pressed against each other with sufficient strength.

List of Reference Numbers

1	work piece 1
2	work piece 2
3	stud
4	joint zone
5	bead
6	bead twisting-off device
7	holding-down device
8	driving unit

Patent Claims

1. Method of producing punctual weld joints by means of a friction stud, characterized in that a rotating stud (3) penetrates from the opposite side of the joint zone (4) into the one of the work pieces to be connected in a horizontal position without puncturing the same (Figures 1 to 3), that the work pieces are firmly pressed against each other in the area of the joint zone by means of the pressure of the stud and an axial fixation of the opposite work piece (2) (Fig. 3), that the friction and the pressure cause a temperature rise in the area of the joint zone, that the stud (3) is withdrawn again after the welding process (Fig. 4) or remains on the assembly as a unit (Figures 5 to 6).

2. Method (Figures 7 and 8) according to claim 1, characterized in that the driving unit (8) is stopped shortly before the welding process is terminated, if the joining takes place with a remaining stud.

3. Apparatus (Fig. 7) for the method according to claim 1, characterized in that a bead twisting-off device (6) removes the formed bead simultaneously with the stud.

4. Apparatus (Fig. 8) for the method according to claim 1, characterized in that a holding-down device (7) prevents the work pieces from mutually being lifted off from one another.

5. Method (Fig. 9) according to claim 1, characterized in that several layers of work pieces are joined with each other.